contagion' in online communities and argues that medical analogies such as the references to 'viral' memes are exaggerating the efficiency of information spread online. "Unlike for influenza, to which you're either exposed or not exposed, even the ideas you do encounter have to compete for attention with everything else that you're exposed to," Watts concludes (http://poptech.org/e1_duncan_watts).

A recent modelling study finds that in the situation of a large information overload, randomness has a large role to play (Sci. Rep. (2012), *2*, article number 335, doi:10.1038/srep00335). The authors conclude: "Surprisingly, we can explain the massive heterogeneity in the popularity and persistence of memes as deriving from a combination of the competition for our limited attention and the structure of the social network, without the need to assume different intrinsic values among ideas."

The influx of many conflicting signals may also help to explain the relatively low response in the gaze-following experiment. David Sumpter, one of the co-authors of the study, comments: "I would say that humans have different responses depending upon how important the information is to them. In gaze-following, we found a weak response to the gazes of others, while in fish and ants we found strong quorum-like responses. But if humans had to make their minds up about something important I would imagine that they would use quorum responses because these allow for more accuracy and speedier decisions."

Most of the time — as long as we are not panicking — we humans are quite good at deciding which cues from the crowd to take and which to ignore. Personally, as a keen photographer, I would of course follow the gaze of someone looking up, as there might be a snap in it for me. As animals endowed with consciousness and self-awareness, we humans have the freedom to decide whether we want to do our own thing or go with the herd.

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Q & A

George Poinar

George Poinar, Jr. entered Cornell University as a vertebrate zoology major in the Department of Wildlife Management. He completed graduate studies in the Entomology Department studying the biology and parasites of the alfalfa weevil that was devastating pastures in the Hudson Valley. After graduation, he spent a year at the Rothamsted Experimental Station (now Rothamsted Research) in England, and then continued nematological investigations with Wim Oosterbrink in Wageningen, Alain Chabaud in Paris and I.A. Rubstov in St. Petersburg. He joined the UC Berkeley Department of Entomology in 1964 as head of the Insect Disease Diagnostic Service where he researched nematode parasites of agricultural and medically important insects and investigated biological control possibilities of insect vectors. His interest in palaeontology transpired at Berkeley in 1975 when he was asked to identify nematodes in Mexican amber. From then on, he began studying plant and animal inclusions in amber.

What is the best advice you've been given about a career in biology? To follow your heart and enter the field that holds your interest. Even if job prospects look bleak, if you are dedicated and well prepared, you should eventually find a satisfying position. In my primary school, there was a quotation from Abraham Lincoln hanging in the auditorium that read, "I will study and get ready and some day my chance will come". I kept this simple advice in the back of my mind ever since.

If you knew what you know earlier on, would you still pursue the same career? Definitely! I was fascinated with animals and plants as a young boy and wanted to find a position in biology right after high school. However, my father, who was a professional violinist and Bach scholar, wanted me to become a musician. So, I spent 2–3 hours each day practising the violin and piano. I eventually rebelled and at 15 went to Iowa where I took a job as a farm hand at 75 dollars a month with room and board. Farming was a liberating

experience, but I decided to further my biological interests by applying for entrance in Cornell's Agricultural school. My experience came in handy, as all entering male undergraduates had to pass a 'farm test' before they could be approved for entrance. So after I had milked a cow, backed a tractor with a load of hay through a narrow barn door and identified some grains, I was accepted.

Do you have a 'hero'? My first hero, while still in high school, was Leonardo da Vinci. I spent many hours pondering over his notebooks and marveled at his early experiments. I later became fascinated by the accounts of natural history in Herodotus' *The Persian Wars* and in the works of Pliny the elder, especially his *Naturalis Historia*.

What do you think about the "electronic revolution" in publishing? I think it is a wonderful idea for all scientific information to be freely available to anyone. However, I feel that hard copies of all publications should be maintained in some repository as a backup just in case the on-line system fails.

Do you have any strong views on scientific journals and the peer review system? The problem with peer review has always been the lack of objectivity. Cases where papers are rejected outright because the reviewer does not agree with a proposed theory or does not like the author are not uncommon. Some journals send out review papers without the author's names, and give the author an opportunity to oppose certain reviewers.

What is your greatest ambition? To use amber fossils for revealing past worlds. Using the principle of behavior fixity — the behavior of fossil organisms will be similar to the behavior of their extant descendants at the generic level — my wife and I re-constructed the type of Tertiary forest that existed in Hispaniola based on plants and animals in Dominican amber. We concluded that the amber forest in Hispaniola was similar to today's tropical moist forest, but was much more diverse and contained a number of species that no longer exist in the New World. Conducting parasitological studies in West Africa provided me with crucial background for investigating the antiquity of vector-borne pathogens. Initially, I had no idea it would be possible to detect pathogens like malaria, Leishmania and trypanosomes in amber-preserved vectors. However, special techniques made it feasible. In one case, it was even possible to detect polyhedral viruses in the midgut of a small fly. We also made some surprising discoveries of vector-borne pathogens in Tertiary amber. For instance, a fossil *Plasmodium* malaria was found inside the body of an entombed Dominican amber mosquito, showing that some strains of malaria originated in the New World.

What about older amber fossils? Discovering vertebrate pathogens in insect vectors from Cretaceous amber raised the question of how these pathogens would have affected dinosaurs. Based on inclusions from different Cretaceous deposits, my wife and I wrote a book on how insects could have affected dinosaurs. For instance, insects would have competed with dinosaurs for food, cleaned up their waste and remains and fed on them. We also showed why we felt that diseases played an important role in exterminating the dinosaurs.

What do you think of the quality of the scientific papers today? I am puzzled why so many recent papers seem to ignore relevant older literature. As a result, many of today's papers 're-invent the wheel'. Perhaps new techniques were used but the conclusions match those from earlier reports. Admittedly, one of the most difficult parts of writing a paper is covering all previous work, but this is made much easier today with the internet.

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Quick guide

Vernalization

E. Jean Finnegan

What is vernalization? The word 'vernalization' comes from the Latin *vernalis,* which means 'of spring' — so vernalization means to make 'spring-like'. Plants often flower in the spring, so, in practical terms, vernalization is the promotion of flowering in response to prolonged low temperatures. This response evolved in plants that adapted to regions where the winters are harsh and the growing season relatively short. These plants germinate in the autumn, and are exposed to low temperatures during winter. Then, when the weather warms up, they flower, ensuring that seed development occurs under favourable conditions. In fact, some plants do not flower unless they are exposed to cold.

Plants often use environmental signals to trigger flowering and other processes. What's so special about vernalization? There are several properties of the vernalization response that make it really interesting: 1. Even when the weather warms up, plants remember that they have experienced winter, and will flower much earlier than sibling plants that have not been exposed to winter. 2. Plants know how long the winter lasted; the longer the winter, the earlier the plants will flower. 3. The progeny of vernalized plants do not flower unless they, too, are exposed to winter — so the memory of winter does not pass to the next generation. These properties indicate that vernalization is regulated by an epigenetic mechanism — a mechanism that causes heritable but potentially reversible changes in gene expression. This mechanism differs from genetic mutations in DNA sequence, which are heritable, but not reversible.

Wow! Plants have a memory of winter — how does that work? The memory of winter can be seen from the fact that the flowering response may not occur until several weeks after winter ends. Young seedlings are not competent to flower immediately after winter ends; as the weather warms up, the plants begin to grow, and when developmentally competent they will flower. Plant cells undergo many mitotic divisions between the end of the winter and when flowering is initiated, indicating that the vernalized state must be transmitted from each cell to its daughters through these divisions.

In *Arabidopsis*, the molecular basis for this memory has been worked out. The key gene in the vernalization pathway is a repressor of flowering known as *FLOWERING LOCUS C*, or *FLC*, for short. *FLC* expression is high before winter, but is repressed during the cold; repression of *FLC* is maintained when the weather gets warmer. Repression of *FLC* is associated with marking of the chromatin around the *FLC* gene by Polycomb group proteins that trimethylate lysine 27 in the amino-terminal tail of histone H3 (H3K27me3). This mark is then transmitted through DNA replication and mitotic cell divisions to keep *FLC* in a repressed state. Marking the chromatin in this way is what provides the cellular memory of winter — in fact, chromatin changes are also believed to be associated with the development of memories in our brains.

Plants can't count, so how do they measure the duration of the winter? We now know that the permanent switch between the on and off states of *FLC* occurs independently in individual cells, and that the number of cells that have undergone this switch increases with time in the cold. As time progresses, the *FLC* gene in more cells is switched off, giving an average level of *FLC* expression that is proportional to the duration of the cold. So plants don't need to count because the stochastic nature of the permanent off switch at *FLC* ensures that time is measured by deposition of H3K27me3 on *FLC* chromatin.

If plants have such a good mechanism to remember winter, why is the memory of winter erased in each generation? If the memory of winter was not erased between plant generations, then the progeny